NOTES ON MAPLE COMPUTER ASSIGNMENT

(A) WHERE CAN I DO MY ASSIGNMENT ?

You can do your Maple Assignment in Math. Department on the 5th. floor of Mathematical Sciences Building , Rooms MS 515 , MS 521 or Room MS 571 on drop basis.

You must check time table posted outside these rooms for availability.

However you must have an IT Computer Account. If you don't have an IT account you may fill out an application requesting an account through the campus IT Web site:

http://www.ucalgary.ca/it

or simply go to 7th. floor of Math Sciences Building and Apply!

Warning : Using your own PC Is Not Permitted.

You must Save An Electronic Copy On U Of C Computer Just In Case We Need it for Verification or Cheating Investigation.

(B) IMPORTANT INSTRUCTIONS :

1. Your Assignment must be done on letter size papers. It must also be Stapled and you must have :

   The Official Cover Sheet Clearly Displaying Your U Of C ID Number.

2. You Must **Type** Your Full Name On The First Page Of Your Assignment ; Not On Cover Sheet!!

3. Hand Written Names Or Solutions Will Not Be Accepted. The Entire Assignment Will Be Returned Unmarked.

4. Make sure that you type the problem number say 3 , 4 , ... etc. All problems must be done in Order.

(C) Completed Maple Assignments Must Be Submitted To Your Tutorial Instructor. Any Assignments Brought to Lectures Or Offices Will Not Be Marked.

Note :Your Assignment **Will not be Accepted** If Instructions Of Part (B) **Were Not Strictly Followed**. You Will Receive " ZERO".

(D) DUE DATE : At the end of your Tutorial :

On Tuesday April 06 /2010 : For T01 & T02.

On Thursday April 08 /2010 : For T03 & T04.

There are No Extensions !!

(E) NEED HELP FOR A MAPLE COMMAND?

If you need help say for the Maple Command *RowSpace* just type the following: ?*RowSpace* ; then press Enter!

Good luck To All.

Maple Help

1.General :

(*a*)To type a text such as Your Name , A comment , or an Explanation , click on the " T " on the menu bar on top. to resume typing Mathematics click on the " [> " on the menu bar on top.

(*b*) Each mathematical command must starts with a cursor , namely the symbol > and must ends in a semi colon namely the symbol ;

(*c*) Make sure that each pair of Parentheses : (,) is opened and closed properly.

(*d*) When typing mathematics , No Spaces Necessary.

(*e*) At any time : To clear Maple's internal memory use the command " restart ":

Simply type **restart** after the **cursor** > followed by the semi colon ; then press enter.

2.The Basic Operations :

Addition (+) , Subtraction (−) , Multiplication (∗) , Division (/) , and Powers (^).

Now the function $f = \dfrac{x^3 - 6x - 4}{9 + 5x^{\frac{3}{4}}}$ must be typed in Maple as follows:

> f : =(x^3 − 6 ∗ x − 4)/(9 + 5 ∗ x^(3/4)) ; then press enter.

If your typing is correct you must get : $f := \dfrac{x^3 - 6x - 4}{9 + 5x^{(\frac{3}{4})}}$.

3.Special Notations:

(*a*) The Square Root Function:

In Maple you may type a square root of an expression in two ways.

For example $\sqrt{2 - 5\sin(x)}$ may be typed as :

Either (2 − 5 ∗ sin(x))^(1/2) , Or sqrt(2 − 5 ∗ sin(x))

(*b*) Exponential Functions:

In Maple an exponential function such as e^{1-3x} must be typed as

exp(1 − 3 ∗ x)

(*c*) Logarithmic Functions :

In Maple a logarithmic function such as $\ln(x)$, $\text{Log}_5(x)$ must be typed respectively as :

ln(x) , log [5](x)

Now if you press enter you get :

$\ln(x)$, $\dfrac{\ln(x)}{\ln(5)}$ (the equivalent of $\log_5(x)$).

(*d*) Inverse Trigonometric Functions:

An inverse trigonometric function such as say $\tan^{-1}(x)$ must be typed as $\arctan(x)$.

(*e*) The Number π must be typed in Maple as Pi (with Capital P)!!

4.The Basic Maple Commands:

(*a*) The *evalf* command :

This command is used to evaluate functions :

An Example Find $\ln(4)$,correct to 5 decimal places

evalf (ln(4),6) ; or *evalf* [6] (ln(4)) ;

Now press enter you get :

$$1.38629$$

(*b*) The *fsolve* command:

This command is used to solve equations in a specified variable with or without restrictions.

Here are a couple of examples:

(*a*) Find all zeros of the polynomial function $P(x) = 4x^3 - 60x^2 - 148x - 8$

(*b*) Find all zeros of the polynomial function in the interval $[-1, \infty)$.

For part (a) no restrictions given. Of course we need to solve the equation $y = P(x) = 0$.

Proceed as follows:

$> y := 4 * x\text{^}3 - 60 * x\text{^}2 - 148 * x - 8$

$> fsolve\ (y = 0, x)$;

Now press enter to get :

$$-2.107337569\ ,\ -0.05529831490\ ,\ 17.16263588$$

For part (*b*) replace the last statement by:

$> fsolve(\ y = 0, x = -1..\text{infinity})$;

Now press enter to get :

$$-0.05529831490\ ,\ 17.16263588$$

(*c*) The solve command:

The solve command solves one or more equations or inequalities for their unknowns.

Here is an example : Find open interval where the function $y = \dfrac{7 + 8x - 12x^2}{(1 - 3x)^2}$ is positive or negative.

We proceed as follows :

$> y := (7 + 8 * x - 12 * x\text{^}2)/(1 - 3 * x)\text{^}2$:

Indeed , we need to solve the inequalities $y > 0$ and $y < 0$. We Proceed as follows:
> solve($y > 0$);

Now press Enter to get :

$$\mathrm{Re}\,al\ Range\left(Open\left(-\frac{1}{2}\right), Open\left(\frac{1}{3}\right)\right)\ ,\ \mathrm{Re}\,al\ Range\left(Open\left(\frac{1}{3}\right), Open\left(\frac{7}{6}\right)\right)$$

Next ,

> solve($y < 0$);

Now press Enter to get :

$$\mathrm{Re}\,al\ Range\left(-\infty, Open\left(-\frac{1}{2}\right)\right), \mathrm{Re}\,al\ Range\left(Open\left(\frac{7}{6}\right), \infty\right)$$

(d) The factor command:

This command is used to compute the factorization of a polynomial function with integer , rational , irrational or complex coefficients.

Here is an example : Factor each of the following functions with integer coefficients.

(a) $f(x) = x^3 + x^2 - 5x + 3$ (b) $g(x) = x^4 - 5x^2 - 10x - 6$

(c) $h(x) = \dfrac{3x^3 - 13x^2 + 18x - 8}{x^5 - x^4 - 3x^3 + 3x^2 - 4x + 4}$

We proceed as follows :

For part (a) :

> factor(x^3 + x^2 − 5 ∗ x + 3);

Now press Enter to get :

$$(x + 3)(x - 1)^2$$

For part (b) :

> factor(x^4 − 5 ∗ x^2 − 10 ∗ x − 6);

Now press Enter to get :

$$(x - 3)(x + 1)(x^2 + 2x + 2)$$

For part (c) :

h := (3 ∗ x^3 − 13 ∗ x^2 + 18 ∗ x − 8)/(x^5 − x^4 − 3 ∗ x^3 + 3 ∗ x^2 − 4 ∗ x + 4) ;
> factor(h);

Now press Enter to get :

$$\frac{3x - 4}{(x + 2)(x^2 + 1)}$$

(e) The *simplify* command:

This command is used to simplify your answers.

Here is an example:

Simplify $Q = \dfrac{2x + 3}{x^2 + 4x + 8} - \dfrac{2x + 1}{x^2 + 2x + 5}$

Proceed as follows:

> Q := (2 ∗ x + 3)/(x^2 + 4 ∗ x + 8) − (2 ∗ x + 1)/(x^2 + 2 ∗ x + 5) :

simplify(Q); OR simplify (%);

Now press enter to get :

$$-\frac{2x^2 + 4x - 7}{(x^2 + 4x + 8)(x^2 + 2x + 5)}$$

Some Linear Algebra Commands

Basic Linear Algebra Commands :

Matrix , Column Vector and Row Vector Entry :

In Maple, to enter a **Column Vector** , such as

$$v = \begin{bmatrix} 5 \\ -2 \\ 9 \\ 0 \\ -4 \\ 3 \end{bmatrix}$$

we proceed as follows :

$> \ v := < 5, -2, 9, 0, -4, 3 > ;$

Now press Enter to get :

$$v: = \begin{bmatrix} 5 \\ -2 \\ 9 \\ 0 \\ -4 \\ 3 \end{bmatrix}$$

To enter a **row vector** such as

$$w = \begin{bmatrix} 12 & -6 & 1 & 0 \end{bmatrix}$$

we proceed as follows :

$> w :=< 12|-6|1|0 > ;$

Now press Enter to get

$$w := \begin{bmatrix} 12 & -6 & 1 & 0 \end{bmatrix}$$

Finally to enter a **Matrix** , such as

$$A = \begin{bmatrix} 0 & -2 & 1 & 4 & 6 \\ 3 & 8 & 10 & 9 & -7 \\ 2 & 2 & 1 & 0 & -5 \end{bmatrix}$$

you have two options : Enter Matrix either by the **Rows** or by the **Columns**.

Option #1

If **Rows** are used , we proceed as follows :

$A := \langle\langle 0|-2|1|4|6 \rangle, \langle 3|8|10|9|-7 \rangle, \langle 2|2|1|0|-5 \rangle\rangle ;$

Now press Enter to get :

$$A := \begin{bmatrix} 0 & -2 & 1 & 4 & 6 \\ 3 & 8 & 10 & 9 & -7 \\ 2 & 2 & 1 & 0 & -5 \end{bmatrix}$$

Option #2

If **Columns** are used , we proceed as follows :

$> A := \langle\langle 0,3,2 \rangle | \langle -2,8,2 \rangle | \langle 1,10,1 \rangle | \langle 4,9,0 \rangle | \langle 6,-7,-5 \rangle\rangle ;$

Now press Enter to get

$$A := \begin{bmatrix} 0 & -2 & 1 & 4 & 6 \\ 3 & 8 & 10 & 9 & -7 \\ 2 & 2 & 1 & 0 & -5 \end{bmatrix}$$

Option # 2 is Preferred!!

(1) The *CharacteristicPolynomial* command :

The *CharacteristicPolynomial* command returns the characteristic polynomial of a square matrix A,

namely it computes the polynomial $C_A(\lambda) = \det(\lambda I - A)$.

Here is an Example :

Find the Characteristic polynomial of the matrix

$$K = \begin{bmatrix} 9 & -1 & 8 & -9 \\ 6 & -1 & 5 & -5 \\ -5 & 1 & -4 & 5 \\ 4 & 0 & 5 & -4 \end{bmatrix}$$

Express your answer in factored form.

We proceed as follows:

$with(LinearA\lg ebra):$

$K :=<< 9,6,-5,4 > |< -1,-1,1,0 > |< 8,5,-4,5 > |< -9,-5,5,-4 >>:$

$P := CharacteristicPolynomial(K, lambda)$; factor(P) ;

Now press Enter to get

$$p := 4 + \lambda^4 - 5\lambda^2$$

$$(\lambda - 1)(\lambda - 2)(\lambda + 2)(\lambda + 1)$$

(2)The Ei*genvalues* command :

The Ei*genvalues* command computes the Eigenvalues of a square matrix.

Here is an example:

Find the eigenvalues of the matrix

$$H = \begin{bmatrix} 2 & 2 & 1 \\ 1 & 3 & 1 \\ 1 & 2 & 2 \end{bmatrix}.$$

We proceed as follows :

$with(LinearA\lg ebra)$:

$H :=<< 2,1,1 > |< 2,3,2 > |< 1,1,2 >>:$ Ei$genvalues(H)$;

Now press Enter to get

$$\begin{bmatrix} 5 \\ 1 \\ 1 \end{bmatrix}$$

(3)The Ei*genvectors* command :

The Ei*genvectors* command computes eigenvalues and the associated eigenvectors of a square matrix.

Here is an Example :

Find the eigenvalues and the associated eigenvectors for the matrix

$$F = \begin{bmatrix} -3 & 1 & 0 \\ 7 & 3 & 0 \\ -12 & 4 & 2 \end{bmatrix}.$$

We Proceed as follows:

$with(LinearA\lg ebra)\ :\ F\ :=<<-3,7,-12>|<1,3,4>|<0,0,2>>:\ \ (lambda,v)\ :=\ \mathrm{Ei}\,genvectors(F);$

Now , Press Enter to get

$$\lambda, v := \begin{bmatrix} 4 \\ -4 \\ 2 \end{bmatrix}, \begin{bmatrix} \frac{1}{8} & \frac{3}{8} & 0 \\ \frac{7}{8} & -\frac{3}{8} & 0 \\ 1 & 1 & 1 \end{bmatrix}$$

(4)<u>The *RowSpace* , the *ColumnSbpace* , and the *NullSpace* commands :</u>

The *RowSpace* , *ColumnSpace* , and the *NullSpace* commands provide a *Basis* for the *Row Sapce* , *the Column Space* and the *Null Space of* a matrix (of order *m by n*) respectively.

Here is an example:

Find a Basis for the Row Space , the Column Space and the Null Space for the matrix

$$N = \begin{bmatrix} 1 & 4 & 5 & 2 \\ 2 & 1 & 3 & 0 \\ -1 & 3 & 2 & 2 \end{bmatrix}.$$

We Proceed As follows:

$with(LinearA\lg ebra) : N :=<<1,2,-1>|<4,1,3>|<5,3,2>|<2,0,2>>:$

$RowSpace(N);\ ColumnSpace(N)\ ;\ NullSpace(N);$

Now press Enter to respectively get

$$\left\{\begin{bmatrix} 1 & 0 & 1 & -\frac{2}{7} \end{bmatrix}, \begin{bmatrix} 0 & 1 & 1 & \frac{4}{7} \end{bmatrix}\right\}$$

$$\left\{\begin{bmatrix} 1 \\ 0 \\ 1 \end{bmatrix}, \begin{bmatrix} 0 \\ 1 \\ -1 \end{bmatrix}\right\}$$

$$\left\{\begin{bmatrix} -1 \\ -1 \\ 1 \\ 0 \end{bmatrix}, \begin{bmatrix} \frac{2}{7} \\ -\frac{4}{7} \\ 0 \\ 1 \end{bmatrix}\right\}$$

(5)The *Rank* command :

The *Rank* command computes the Rank of a matrix of order *m by n*.

Here is an Example:

Find the Rank of the linear transformation

$T : \mathbb{R}^3 \rightarrow \mathbb{R}^4$;

$T(x_1,x_2,x_3) = (x_1 + 4x_2 + 5x_3 , 3x_1 - 2x_2 + x_3 , -x_1 - x_3 , 2x_1 + 3x_2 + 5x_3)$.

First observe that $Rank(T) = r = Rank(A)$, where A is the **Standard Matrix** of T , and is given by

$$A = \begin{bmatrix} 1 & 4 & 5 \\ 3 & -2 & 1 \\ -1 & 0 & -1 \\ 2 & 3 & 5 \end{bmatrix}$$

To find $Rank(T)$, we proceed as follows:

$with(LinearA\lg ebra) : A :=<< 1,3,-1,2 > |< 4,-2,0,3 > |< 5,1,-1,5 >> : r := Rank(A);$

Now press Enter to get

$$r := 2$$

(6)The *GramSchmidt* command :

The *GramSchmidt* command convert a Basis (or a linearly independent set of vectors) into an orthogonal or orthonormal Basis.

Here is an example:

Use *Gram − Schmidt* process to convert the basis $B = \{(1,1,1) , (-1,1,0) , (1,2,1)\}$ of $\mathbb{R}^3$ into

(a) an orthogonal basis.

(b) an orthonormal basis.

We proceed as follows :

Part (a)

$with(linearA\lg ebra) : u :=< 1,1,1 > : v :=< -1,1,0 > : w :=< 1,2,1 > : GramSChmidt(\{u,v,w\});$

Now press Enter to get

$$\left\{ \begin{bmatrix} \frac{1}{6} \\ \frac{1}{6} \\ -\frac{1}{3} \end{bmatrix}, \begin{bmatrix} -1 \\ 1 \\ 0 \end{bmatrix}, \begin{bmatrix} 1 \\ 1 \\ 1 \end{bmatrix} \right\}$$

Part (b)

$with(linearA\lg ebra) : u :=< 1,1,1 > : v :=< -1,1,0 > : w :=< 1,2,1 > : GramSChmidt(\{u,v,w\}, normalized);$

$$\left\{ \begin{bmatrix} -\frac{1}{2}\sqrt{2} \\ \frac{1}{2}\sqrt{2} \\ 0 \end{bmatrix}, \begin{bmatrix} \frac{1}{3}\sqrt{3} \\ \frac{1}{3}\sqrt{3} \\ \frac{1}{3}\sqrt{3} \end{bmatrix}, \begin{bmatrix} \frac{1}{6}\sqrt{6} \\ \frac{1}{6}\sqrt{6} \\ -\frac{1}{3}\sqrt{6} \end{bmatrix} \right\}$$

(7)The *Basis* command :

The *Basis* command reduces a spanning set of a subspace U (or a vector space U) to a Basis for U.

Here is an Example:

Let U be the subspace of $\mathbb{R}^4$ spanned by the set of vectors :

$$S = \{(1,2,0,2) , (0,-2,10,8) , (-2,-5,5,6) , (0,-3,15,18) , (3,6,0,6)\}$$

We Proceed as follows :

$with(LinearA\lg ebra) : u1 :=< 1|2|0|2 >: u2 :=< 0|-2|10|8 >: u3 :=< -2|-5|5|6 >: u4 :=< 0|-3|15|18 >:$

$u5 :=< 3|6|0|6 >: Basis(\{u1,u2,u3,u4,u5\}) ;$

Now press Enter to get

$$\left\{ \begin{bmatrix} 1 & 2 & 0 & 2 \end{bmatrix}, \begin{bmatrix} 0 & -2 & 10 & 18 \end{bmatrix}, \begin{bmatrix} -2 & -5 & 5 & 6 \end{bmatrix} \right\}$$

Refer to Maple Help Work Sheet For All Examples Presented In This Help **Sheet**. **Good Luck To All**.

MAPLE WORKSHEET

YOUR NAME : ....

#1

```
> f:=(x^3-6*x-4)/(9+5*x^(3/4));
```

$$f := \frac{x^3 - 6x - 4}{9 + 5x^{(3/4)}} \quad \textbf{(1)}$$

#2

```
> (2-5*sin(x))^(1/2);
```

$$\sqrt{2 - 5\sin(x)} \quad \textbf{(2)}$$

```
> sqrt(2-5*sin(x));
```

$$\sqrt{2 - 5\sin(x)} \quad \textbf{(3)}$$

#3

```
> exp(1-3*x);
```

$$e^{(1 - 3x)} \quad \textbf{(4)}$$

```
> ln(x);
```

$$\ln(x) \quad \textbf{(5)}$$

```
> log[5](x);
```

$$\frac{\ln(x)}{\ln(5)} \quad \textbf{(6)}$$

#4

```
> arctan(x);
```

$$\arctan(x) \quad \textbf{(7)}$$

#5

```
> evalf(ln(4),6);
```

$$1.38629 \quad \textbf{(8)}$$

```
> evalf[6](ln(4));
```

$$1.38629 \quad \textbf{(9)}$$

#6

```
> y:=4*x^3-60*x^2-148*x-8 : fsolve(y=0,x);
```

$$-2.107337569, -0.05529831490, 17.16263588 \quad \textbf{(10)}$$

with the restriction given , we get

> $fsolve(y = 0, x = -1 .. \infty);$

$$-0.05529831490, 17.16263588 \quad \textbf{(11)}$$

7

> $y := \frac{(7+8x-12x^2)}{(1-3\cdot x)^2}$: $solve(y>0,x)$;

$$RealRange\left(Open\left(-\frac{1}{2}\right), Open\left(\frac{1}{3}\right)\right), RealRange\left(Open\left(\frac{1}{3}\right), Open\left(\frac{7}{6}\right)\right) \quad \textbf{(12)}$$

> $solve(y<0)$;

$$RealRange\left(-\infty, Open\left(-\frac{1}{2}\right)\right), RealRange\left(Open\left(\frac{7}{6}\right), \infty\right) \quad \textbf{(13)}$$

#8

> $factor(x^3+x^2-5x+3)$;

$$(x+3)\,(x-1)^2 \quad \textbf{(14)}$$

#9

> $factor(x^4-5x^2-10x-6)$;

$$(x-3)\,(x+1)\,(x^2+2x+2) \quad \textbf{(15)}$$

#10

> $h := \frac{(3x^3-13x^2+18x-8)}{(x^5-x^4-3x^3+3x^2-4x+4)}$: $factor(h)$;

$$\frac{3x-4}{(x+2)\,(x^2+1)} \quad \textbf{(16)}$$

#11

```
> Q:=(2*x+3)/(x^2+4*x+8)-(2*x+1)/(x^2+2*x+5):simplify(Q);
```

$$-\frac{2x^2+4x-7}{(x^2+4x+8)\,(x^2+2x+5)} \quad \textbf{(17)}$$

#12

> $v := \langle 5, -2, 9, 0, -4, 3\rangle$;

$$v := \begin{bmatrix} 5 \\ -2 \\ 9 \\ 0 \\ -4 \\ 3 \end{bmatrix} \quad \textbf{(18)}$$

13

> $w := \langle 12|-6|1|0\rangle$;

$$w := \begin{bmatrix} 12 & -6 & 1 & 0 \end{bmatrix} \quad \textbf{(19)}$$

14

Option (1):

> $A := \langle\langle 0|-2|1|4|6\rangle, \langle 3|8|10|9|-7\rangle, \langle 2|2|1|0|-5\rangle\rangle$;

$$A := \begin{bmatrix} 0 & -2 & 1 & 4 & 6 \\ 3 & 8 & 10 & 9 & -7 \\ 2 & 2 & 1 & 0 & -5 \end{bmatrix} \quad (20)$$

Option (2)

> $A := \langle\langle 0, 3, 2\rangle | \langle -2, 8, 2\rangle | \langle 1, 10, 1\rangle | \langle 4, 9, 0\rangle | \langle 6, -7, -5\rangle\rangle;$

$$A := \begin{bmatrix} 0 & -2 & 1 & 4 & 6 \\ 3 & 8 & 10 & 9 & -7 \\ 2 & 2 & 1 & 0 & -5 \end{bmatrix} \quad (21)$$

15

> $with(LinearAlgebra) : K := \langle\langle 9, 6, -5, 4\rangle | \langle -1, -1, 1, 0\rangle | \langle 8, 5, -4, 5\rangle | \langle -9, -5, 5, -4\rangle\rangle : P := CharacteristicPolynomial(K, \lambda); factor(P);$

$$P := 4 + \lambda^4 - 5\lambda^2$$

$$(\lambda - 1)(\lambda - 2)(\lambda + 2)(\lambda + 1) \quad (22)$$

16

> $with(LinearAlgebra) : H := \langle\langle 2, 1, 1\rangle | \langle 2, 3, 2\rangle | \langle 1, 1, 2\rangle\rangle : Eigenvalues(H);$

$$\begin{bmatrix} 5 \\ 1 \\ 1 \end{bmatrix} \quad (23)$$

17

> $with(LinearAlgebra) : F := \langle\langle -3, 7, -12\rangle | \langle 1, 3, 4\rangle | \langle 0, 0, 2\rangle\rangle : (\lambda, v) := Eigenvectors(F);$

$$\lambda, v := \begin{bmatrix} 4 \\ -4 \\ 2 \end{bmatrix}, \begin{bmatrix} \frac{1}{8} & \frac{3}{8} & 0 \\ \frac{7}{8} & -\frac{3}{8} & 0 \\ 1 & 1 & 1 \end{bmatrix} \quad (24)$$

#18

> $with(LinearAlgebra) : N := \langle\langle 1, 2, -1\rangle | \langle 4, 1, 3\rangle | \langle 5, 3, 2\rangle | \langle 2, 0, 2\rangle\rangle : RowSpace(N); ColumnSpace(N); NullSpace(N);$

$$\left[\begin{bmatrix} 1 & 0 & 1 & -\frac{2}{7} \end{bmatrix}, \begin{bmatrix} 0 & 1 & 1 & \frac{4}{7} \end{bmatrix}\right]$$

$$\left[\begin{bmatrix} 1 \\ 0 \\ 1 \end{bmatrix}, \begin{bmatrix} 0 \\ 1 \\ -1 \end{bmatrix}\right]$$

$$\left\{\begin{bmatrix} -1 \\ -1 \\ 1 \\ 0 \end{bmatrix}, \begin{bmatrix} \frac{2}{7} \\ -\frac{4}{7} \\ 0 \\ 1 \end{bmatrix}\right\} \quad \textbf{(25)}$$

19

> *with*(*LinearAlgebra*) : *A* := ⟨⟨1, 3, −1, 2⟩|⟨4, −2, 0, 3⟩|⟨5, 1, −1, 5⟩⟩ : *r* := *Rank*(*A*);

$$r := 2 \quad \textbf{(26)}$$

20

> *with*(*LinearAlgebra*) : *u* := ⟨1, 1, 1⟩ : *v* := ⟨−1, 1, 0⟩ : *w* := ⟨1, 2, 1⟩ : *GramSchmidt*({*u*, *v*, *w*});

$$\left\{\begin{bmatrix} \frac{1}{6} \\ \frac{1}{6} \\ -\frac{1}{3} \end{bmatrix}, \begin{bmatrix} -1 \\ 1 \\ 0 \end{bmatrix}, \begin{bmatrix} 1 \\ 1 \\ 1 \end{bmatrix}\right\} \quad \textbf{(27)}$$

21

> *with*(*LinearAlgebra*) : *u* := ⟨1, 1, 1⟩ : *v* := ⟨−1, 1, 0⟩ : *w* := ⟨1, 2, 1⟩ : *GramSchmidt*({*u*, *v*, *w*}, *normalized*);

$$\left\{\begin{bmatrix} -\frac{1}{2}\sqrt{2} \\ \frac{1}{2}\sqrt{2} \\ 0 \end{bmatrix}, \begin{bmatrix} \frac{1}{6}\sqrt{6} \\ \frac{1}{6}\sqrt{6} \\ -\frac{1}{3}\sqrt{6} \end{bmatrix}, \begin{bmatrix} \frac{1}{3}\sqrt{3} \\ \frac{1}{3}\sqrt{3} \\ \frac{1}{3}\sqrt{3} \end{bmatrix}\right\} \quad \textbf{(28)}$$

22

> *with*(*LinearAlgebra*) : *u1* := ⟨1|2|0|2⟩ : *u2* := ⟨0|−2|10|8⟩ : *u3* := ⟨−2|−5|5|6⟩ : *u4* := ⟨0|−3|15|18⟩ : *u5* := ⟨3|6|0|6⟩ : *Basis*({*u1*, *u2*, *u3*, *u4*, *u5*});

$$\left\{\begin{bmatrix} 1 & 2 & 0 & 2 \end{bmatrix}, \begin{bmatrix} 0 & -2 & 10 & 8 \end{bmatrix}, \begin{bmatrix} -2 & -5 & 5 & 6 \end{bmatrix}\right\} \quad \textbf{(29)}$$

>

MAPLE ASSIGNMENT OFFICIAL COVER SHEET

Due Date : Tuesday April 06 / Thursday April 08 / 2010

(AT END OF YOUR TUTORIAL)

U OF C ID #	

Tutorial #	T ( )

DO NOT WRITE YOUR NAME ON COVER SHEET

TYPE YOUR NAME ON THE TOP RIGHT HAND CORNER

OF FIRST PAGE OF YOUR ASSIGNMENT

WARNING

COPYING ASSIGNMENT FROM ANOTHER INDIVIDUAL OR

SHARING SOME ONE'S ACCOUNT IS STRICTLY PROHIBITED.

CHEATING / PLAGIARISM IS AN EXTREMELY

SERIOUS ACADEMIC OFFENCE.

ALL CHEATING CASES **WILL BE REPORTED** To

THE DEAN OF YOUR FACULTY

I agree that this paper may be placed at the front of the classroom for pick-up. Please Circle : Yes or No.

DEPARTMENT OF MATHEMATICS AND STATISTICS

MATH 311 MAPLE COMPUTER ASSIGNMENT

Due Date : April 06 or 08 / 2010

(At End Of Your Tutorial)

1. Given the Matrix $C = \begin{bmatrix} 3 & 2 & 2 & -4 \\ 2 & 3 & 2 & -1 \\ 1 & 1 & 2 & -1 \\ 2 & 2 & 2 & -1 \end{bmatrix}$

(i) Use the command *CharacteristicPolynomial* and the command factor to find the characteristic polynomial P of the matrix C.

(ii) Use the command Ei*genvalues* to find the eigenvalues of the matrix C

(iii) Use the Command Ei*genvectors* to find corresponding eigenvectors of the matrix C

2. Let $B = \{(2,1,0,-1),(1,0,2,-1),(0,-2,1,0)\}$ be a basis for the subspace U of $\mathbb{R}^4$.

Use the command *GramSchmidt* to convert B into an orthonormal basis.

3. Use the command *Basis* to find a basis for the subspace W of $\mathbb{R}^4$ spanned by the set $S = \{(1,-1,5,2),(-2,3,1,0),(4,-5,9,4),(0,4,2,-3),(-7,18,2,-8)\}$.

4. Let $T : \mathbb{R}^3 \rightarrow \mathbb{R}^4$ be the linear transformation given by

$$T(x,y,z) = (x-2y+4z\ ,-2x+5y+3z\ ,3x-7y+z,\ 5x-11y+9z).$$

(i) Find the standard matrix of T.

(ii) Use the command *NullSpace* to find a basis for $Ker(T)$.

(iii) Use the command *Rank* to find $Rank(T)$.

5. Let $F = \begin{bmatrix} 1 & 4 & 5 & 6 & 9 \\ 3 & -2 & 1 & 4 & -1 \\ -1 & 0 & -1 & -2 & -1 \\ 2 & 3 & 5 & 7 & 8 \end{bmatrix}$

(i) Use the command *RowSpace* to find a basis for $Row(A)$.

(ii) Use The command *ColumnSpace* to find a basis for $Col(A)$.